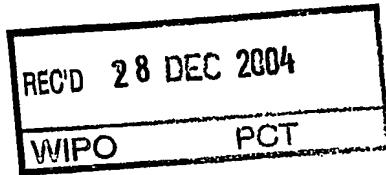


PCT/NZ2004/000297



## CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 3 October 2003 with an application for Letters Patent number 528617 made by SYFT Technologies Limited.

I further certify that the Provisional Specification has since been post-dated to 25 November 2003 under Section 12(3) of the Patents Act 1953.

Dated 13 December 2004.

**PRIORITY DOCUMENT**  
SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH  
RULE 17.1(a) OR (b)

A handwritten signature in black ink, appearing to read "Neville Harris".

Neville Harris  
Commissioner of Patents, Trade Marks and Designs



**BEST AVAILABLE COPY**

528617

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**Patents Form No.4**

20 PATENTS ACT 1953



**PROVISIONAL SPECIFICATION**

Improvements in or relating to SIFT-MS instruments

25

We, **SYFT Technologies Limited**, a New Zealand company, of 3 Craft Place, Middleton, Christchurch, New Zealand, do hereby declare this invention to be described in the following statement:

30

INTELLECTUAL PROPERTY OFFICE OF N.Z.
- 3 OCT 2003
<b>RECEIVED</b>

**TITLE:**

Improvements in or relating to SIFT-MS instruments.

**Background to the invention**

5        Selected ion flow tube (SIFT), technique is a fast flow tube/ion swarm method for the study of positive or negative ions with atoms and molecules. In SIFT apparatus, the ions are created in an ion source which is external to the flow tube. The ions are then extracted from the ion source by a quadrupole mass filter which acts on the incident ion beam to create a pure species of ion beam (precursor). An electrostatic lens is then used to  
10      focus the ion beam which is injected into one end of a flow tube which has a flowing carrier gas, usually helium. The carrier gas is prevented from entering the quadrupole mass filter by being injected into the flow tube through a venturi in a direction away from the orifice. This enables the swarm of single ion species to be thermalised at the same temperature as the carrier gas flows along the flow tube and quickly establishes a laminar flow of gases  
15      through the flow tube. The flow tube communicates via a downstream orifice with a downstream chamber housing a quadrupole mass spectrometer system where the ions are mass analysed and counted.

20      This form of instrument requires a chamber for the upstream quadrupole mass filter which is connected by the flow tube to a separate generally substantially identical chamber in which the downstream quadrupole mass spectrometer is housed. To allow the quadrupole mass filters to operate effectively, the interiors of both the upstream and the downstream chambers are pressurised at a pressure generally of about  $10^{-6}$  Torr which is created by individual pumps. The pressure in the flow tube is generally much less than the  
25      pressure in the chambers and generally is in the order of  $10^{-1}$  Torr.

Because of the requirement of having separate chambers and because of the comparatively substantial size and capacity of the two pumps, a SIFT-MS instrument is of a substantial size. In addition because of the type of the pumps needed, considerable noise  
30      can be created when the instrument is operating. If the SIFT-MS instrument is to be made at all portable, it is highly desirable that the instrument including the pumps be housed

within a suitably small structure and because of the size and capacity of the pumps it is necessary that considerable attention also be given to adequate sound deadening.

**Object of the invention**

5 It is therefore an object of this invention to provide an improved form of SIFT-MS apparatus which can be more portable than previously known instruments and in which the size and combined weight of the various components of the instrument, particularly the high pressure pumps can be downsized from that previously known.

10 **Disclosure of the invention**

Accordingly in one form the invention comprises a SIFT-MS instrument including a downstream quadrupole mass filter and an upstream quadrupole mass filter housed together within a single pressurised chamber and wherein a curved flow tube connects the outlet of the upstream quadrupole mass filter to the inlet of the downstream quadrupole mass filter,  
15 the said flow tube being pressurised at a lower pressure than that of the chamber.

Preferably a non-reactive gas (or mixture of such gases) is injected into the flow tube to flow through the tube by the action of a vacuum pump.

20 Preferably the non-reactive gas is helium.

Preferably the injection of the non reactive gas or mixture of gases is effected through a venturi and the design of the curved flow tube and venturi contributes to a laminar flow of the gas-ion mixture through the flow tube.

25 Preferably the flow tube is curved.

Preferably the flow tube includes two bends which join a straight tube.

30 Preferably the precursor ion beams from the upstream quadrupole mass filter are injected into one end of the flow tube.

Preferably the chamber is pressurised by a single pump.

Preferably an electrostatic shield is located in the chamber to separate the upstream  
5 quadrupole mass filter from the downstream quadrupole mass filter.

Preferably an electrostatic lens is associated with the upstream quadrupole mass  
filter.

10 Preferably an electrostatic lens is associated with the downstream quadrupole mass  
filter.

#### **Brief description of the drawings**

Figure 1 is a schematic diagram of a known form of SIFT-MS instrument.

15 Figure 2 is a schematic diagram of the improved form of SIFT-MS instrument  
according to the present invention.

#### **Description of the preferred embodiments of the invention.**

20 As illustrated in Figure 1, a known form of SIFT-MS instrument may comprise an  
upstream chamber 1 to which an ion source 2 is connected. The upstream chamber houses  
a quadrupole mass filter 3 through which the ion stream is passed. The upstream chamber  
is held at a pressure, generally  $10^{-6}$  Torr to enable correct operation of the quadrupole 3.  
The ion stream is focused by the lens 4 before it passes through an ion injection orifice  
25 located as part of the venturi plate 8, to enter the flow tube 6.

The flow tube 6 is generally held at a pressure of approximately  $10^{-1}$  Torr and a  
30 stream of a non-reactive carrier gas or gas mixture, typically helium is injected at 8 into the  
flow tube in a manner that a venturi effect is obtained to prevent the ion stream from the  
chamber 1 and the non-reactive gas from escaping back into the upstream chamber.

Additional non-reactive carrier gas or gas mixture can be injected at additional points along tube 6.

The sample of the volatile organic compound (VOC) is injected at 7 into the flow  
5 tube and reacts with the incident beam of ions, the result of which is a transfer of ions to the VOC. The charged VOCs then enter the downstream chamber through a small injection orifice 11 with the downstream chamber 10 generally held at a similar pressure ( $10^{-6}$  Torr) to the upstream chamber 1. As in the case of the upstream chamber, the downstream chamber 10 is normally evacuated by means of a turbo pump 12 or similar. The  
10 downstream chamber includes a set of lenses 13 and a quadrupole mass filter 14 with a detector device 15 by which the masses of the incident VOCs and precursor ions are measured. Backing pumps are shown at 16 and these allow the chambers 1 and 10 to be evacuated sufficiently to allow turbo pumps 12 to maintain the desired chamber pressure.

15 The improved SIFT-MS instrument is illustrated diagrammatically in Figure 2. As illustrated, the upstream chamber 1 and the downstream chamber 10 of Figure 1 are dispensed with and a single combined chamber 20 is provided which is pressurised by a single pump 21 preferably at a pressure of  $10^{-6}$  Torr. The chamber 20 includes an upstream quadrupole 22 and lens 23 to extract the ions from the ion source 2 with the extracted ions  
20 being focused through the lens and injected into a flow tube 24 through which a stream of non-reactive carrier gas is passed. The flow tube 24 is maintained at an appropriate pressure, typically  $10^{-1}$  Torr by a pump 26. The flow tube 24 instead of being an essentially straight tube which connected an upstream chamber to a downstream chamber as in the case of the prior art instrument illustrated in Figure 1, in the improvement provided by this  
25 invention, the flow tube is curved as illustrated. The sample VOCs are injected into the flow tube 24 to react with the beam of ions which then enters the chamber 20 through an ion sampling orifice 25 where it is focused by the lens 28 into the quadrupole mass filter 29 which acts as a mass selector prior to analysis by the detector 15. An appropriate electrostatic shield (not shown in the drawing) is located within the chamber 20 to  
30 electrostatically separate the quadrupole mass filter 22 and lens 23 from the lens 28 and quadrupole mass filter 29. Backing pumps are shown at 30 and these allow the chamber 20

to be evacuated sufficiently to allow turbo pump 21 to maintain the desired chamber pressure.

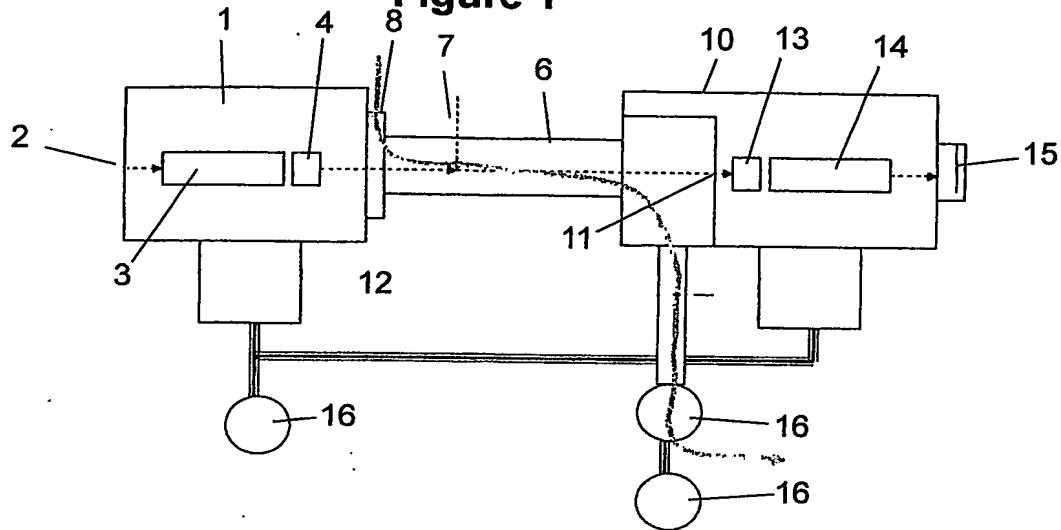
As in the case of the instrument illustrated in Figure 1, a non-reactive gas such as 5 helium and the precursor ions are injected into one end of the flow tube and flow along the tube, the flow being created by the action of the vacuum pump. It is therefore possible to maintain laminar flow after injection of the sample VOCs.

Because of the improvements in the instrument brought about by the present 10 invention, it is possible to make the whole instrument considerably physically smaller with less componentry than that previously required. This provides significant savings in the cost in the manufacture of the instrument. In addition, because only a single pump is used, less electrical power is required and less noise is generated. This reduces the considerable amount of sound insulation that was previously required. It is to be understood this is a 15 major advantage when constructing the instrument as a portable instrument because this will result in a reduction of the number of component parts and consequently in the size of the machine and in the weight of the machine

Having described the preferred embodiments of the invention it will be apparent to 20 those skilled in the art that various changes and alterations can be made to the embodiments and yet still come within the general concept of the invention. All such changes and alterations are intended to be included in the scope of this specification



**Figure 1**



**Figure 2**

